

REMARKS

Initially, in the Office Action dated April 16, 2004, the Examiner rejects claims 24-52 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,271,110 (Yamaguchi et al.) or U.S. Patent No. 5,592,736 (Akram et al.) or Japanese Patent No. 08-191072 (Takahiro et al.) in view of Japanese Patent No. 05-121409 (Akira), U.S. Patent No. 5,643,831 (Ochiai et al.) and Japanese Patent No. 05-06221 (Michihiko et al.). Claim 53 is allowable over the prior art.

By the present response, Applicant has amended claim 34 to further clarify the invention. Claims 34-53 remain pending in the present application.

Allowable Subject Matter

Applicants thank the Examiner for the allowance of claim 53.

35 U.S.C. §103 Rejections

Claims 24-52 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Yamaguchi et al., Akram et al., Takahiro et al. in view of Akira, Ochiai et al. and Michihiko et al. Applicants have discussed the deficiencies of each of these references in Applicants' previously filed responses and reassert all arguments submitted in these responses. Applicants provide the following additional remarks.

Regarding claim 34, Applicants submit that none of the cited references, taken alone or in any proper combination, disclose, suggest or render obvious the limitations in the combination of this claim of, inter alia, producing a semiconductor device that includes forming a plurality of pyramidal bump electrodes of the semiconductor device, where the forming includes forming etched holes by

anisotropically etching a base material having a crystal orientation, and filling up the etched holes by plating a metal to form the pyramidal bump electrodes by transferring a shape of the etched holes. According to the limitations in the claims of the present application, the shape of the anisotropically etched hole is transferred and the hole is filled by metal plating for forming the bump electrode of the "pyramidal shape". Therefore, bump electrodes are realized with the high precision shape and tip position, and the semiconductor device with the high-density installation by using the internal connection of the semiconductor device.

Yamaguchi et al. discloses the hole of the pyramidal shape, which is formed by anisotropically etching the member. However, the purpose of Yamaguchi et al. is to form the bump of the ball shape by using the pyramidal shape. Namely, Yamaguchi et al. does not disclose to form the bump of the pyramidal shape. Accordingly, Yamaguchi et al. does not disclose or suggest to form the bump shape by transferring the anisotropically etched hole, as recited in the claims of the present application.

Fig. 9 of Yamaguchi et al. discloses a "replica die" formed by transferring the anisotropically etched hole. However, this "replica die" is not the bump electrode but the casing mold. Therefore, Yamaguchi et al. is different from the present invention and does not disclose or suggest a bump electrode, as recited in the claims of the present application.

Akram et al. discloses to form the bump electrode of the pyramidal shape by anisotropically etching silicon. However, in Akram et al., the protruded portion is provided with silicon to cover the protruded portion with the conductive material.

This is not an anisotropically etched hole being transferred to form the bump, as recited in the claims of the present application.

In addition, in the fabrication method of Akram et al., the shape of the bump appears pyramidal at a glance. However, since the protrusion of the pyramidal shape is covered with the conductive material, the protruded portion of the pyramidal shape becomes blunt, therefore, a protruded portion of the pyramidal shape cannot be realized practically.

In Akira, the member is anisotropically etched to form the hole of the pyramidal shape which is filled to form the bump. However, in Akira, the shape of the hole becomes round. Akira does not disclose or suggest a shape of the bump being pyramidal or that the shape of the bump is formed by the transfer of the hole shape, as recited in the claims of the present application.

In Ochiai et al., the member is anisotropically etched to form the hole of the pyramidal shape, and the hole is filled with solder paste. However, the purpose of Ochiai et al. is to form the ball-like bump by heating. Ochiai et al. does not disclose or suggest the shape of the bump being pyramidal, the shape of the bump being formed by the transfer of the shape of the hole, or the hole being filled by the metal plating, as recited in the claims of the present application.

As indicated by the Examiner, Michihiko et al. discloses that the layer of the same material as the metal for the plating is provided on the member. However, similarly to the references described above, Michihiko et al. does not disclose or suggest the shape of the bump being pyramidal, the shape of the bump being

formed by the transfer of the shape of the hole, or the hole being filled by the metal plating, as recited in the claims of the present application.

In addition, Michihiko et al. discloses the bump of the shape of the circular cone. However, the premise of Michihiko et al. is the melt transformation. So, the fabrication method of Michihiko et al. is different from that of the present invention.

Regarding claims 35-52, Applicants submit that these claims are dependent on independent claim 34 and, therefore, are patentable at least for the same reasons noted regarding this independent claim. For example, none of the cited references disclose or suggest where the forming etched holes and the filling up of the etched holes further includes forming a primary film of the same material as the metal for the plating of the metal on the base material having a crystal orientation and on a side surface of each of the etched holes, thereby filling up the etched holes by plating the metal by using the primary film.

Accordingly, Applicants submit that none of the cited references, taken alone or in any proper combination, disclose, suggest or render obvious the limitations in the combination of each of claims 34-52 of the present application. Applicants respectfully request that these rejections be withdrawn and that these claims be allowed.

In view of the foregoing amendments and remarks, Applicants submit that claims 34-53 are now in condition for allowance. Accordingly, early allowance of such claims is respectfully requested.

U.S. Application No. 09/462,796

To the extent necessary, Applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, or credit any overpayment of fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (referencing attorney docket no. 500.38090X00).

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP



Frederick D. Bailey
Registration No. 42,282

FDB/sdb
(703) 312-6600